

# Fiber-Optic Sensors

*Monitor, measure, and characterize chemicals and conditions in remote environments*

**W**e are exploring several fiber-optic-based methods for remote chemical sensing. Methods fall into two categories: remote fiber spectroscopy (RFS) and chemically specific optrodes.

In RFS, light transmitted to the sample region via the fiber optic is used to perform a direct spectroscopic measurement. This type of analysis encompasses many spectroscopic methods (such as Raman, surface-enhanced Raman, absorption, reflectance, and fluorescence spectroscopies) that have been adapted for use with optical fibers.

In chemically specific optrodes, transmitted light probes an intermediate material affixed to the terminal end of the fiber which interacts with the analyte to produce an optical signal.

## APPLICATIONS

- Characterize contaminant concentrations at environmental remediation and waste disposal sites
- Monitor in situ bioremediation processes
- Measure volatile organochlorides in contaminated aquifers
- Measure algae fluorescence in sea water
- Identify chemical striation of complex waste samples
- Analyze surfaces with spatial chemical resolution

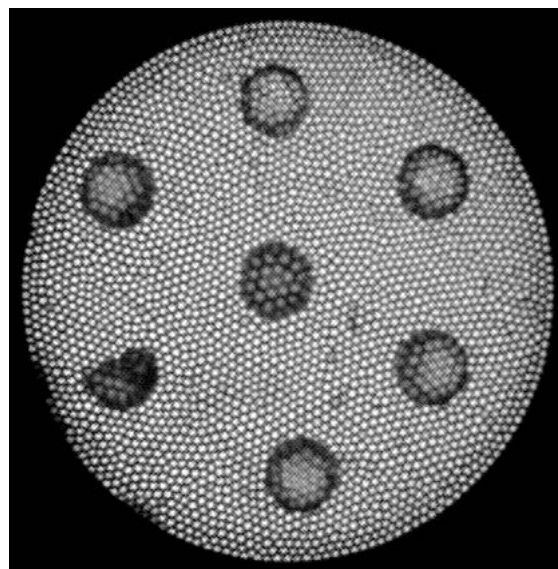
## Environmental and biomedical research

We are evaluating these sensors for environmental and biomedical applications, particularly for monitoring ground water contaminants. Remote detection with optical fibers is effective for monitoring in situ contaminants that are often volatile and difficult to sample accurately. In some cases, the use of fiber-optic sensors provides a more sensitive and rapid method for screening pollutants. We are investigating multi-analyte fiber-optic probes for the simultaneous detection and measurement of contaminants

in aqueous waste streams using a single fiber optrode. Our interests include chlorocarbon solvents, aluminum ion, uranyl ion, and pH.

## Monitoring contaminants

We are developing techniques to remotely monitor contaminant concentrations at environmental remediation and waste disposal sites. We are now completing development on



Microphotograph of a multi-analyte fiber optic chemical sensor. Seven independent sensing elements have been deposited on the end of a single 350-micrometer imaging fiber.

a multi-point, near-visible, fiber-optic Raman spectrometry system for use in underground storage tanks to measure important components in the waste (e.g., nitrates, sulfates, cyanides). Of particular interest are ferri- and ferrocyanide ions that are typically found at relatively high levels and are not easily measured remotely by other techniques. We are also investigating scanning Raman imaging systems for real-time surface profiling of tank core samples in hot cells and for mapping the surface of the waste salt cakes in the tank.

**Availability:** Optical fibers offer tremendous potential for remote and in situ measurements. We welcome discussions with potential partners from industry.

## Contacts

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